

What is claimed is:

1. A polypeptide chain useful as a subunit of a dimeric osteogenic protein comprising a pair of disulfide-bonded polypeptide chains,

said polypeptide chain having an amino acid sequence sufficiently duplicative of Sequence ID No. 1 or Sequence ID No. 3 such that the dimeric osteogenic protein comprising said polypeptide chain has a conformation capable of inducing endochondral bone formation when implanted in a mammal in association with a matrix.

2. The polypeptide chain of claim 1 wherein the sequence comprises (Sequence ID No. 1):

mOP-2

Ala	Ala	Arg	Pro	Leu	Lys	Arg	Arg	Gln
1				5				
Pro	Lys	Lys	Thr	Asn	Glu	Ile	Pro	His
10					15			
Pro	Asn	Lys	Leu	Pro	Gly	Ile	Phe	Asp
	20					25		
Asp	Gly	His	Gly	Ser	Arg	Gly	Arg	Glu
		30					35	
Val	Cys	Arg	Arg	His	Glu	Ile	Tyr	Val
			40					45
Arg	Phe	Arg	Asp	Leu	Gly	Trp	Leu	Asp
				50				
Trp	Val	Ile	Ala	Pro	Gln	Gly	Tyr	Ser
55					60			

Ala	Tyr	Tyr	Cys	Glu	Gly	Glu	Cys	Ala
	65					70		
Phe	Pro	Leu	Asp	Ser	Cys	Met	Asn	Ala
		75					80	
Thr	Asn	His	Ala	Ile	Leu	Gln	Ser	Leu
			85					90
Val	His	Leu	Met	Lys	Pro	Asp	Val	Val
				95				
Pro	Lys	Ala	Cys	Cys	Ala	Pro	Thr	Lys
100					105			
Leu	Ser	Ala	Thr	Ser	Val	Leu	Tyr	Tyr
	110					115		
Asp	Ser	Ser	Asn	Asn	Val	Ile	Leu	Arg
		120					125	
Lys	His	Arg	Asn	Met	Val	Val	Lys	Ala
			130					135
Cys	Gly	Cys	His.					

3. The polypeptide chain of claim 1 wherein the sequence comprises (Sequence ID No. 3):

hOP-2

Ala	Val	Arg	Pro	Leu	Arg	Arg	Arg	Gln
1				5				
Pro	Lys	Lys	Ser	Asn	Glu	Leu	Pro	Gln
10					15			
Ala	Asn	Arg	Leu	Pro	Gly	Ile	Phe	Asp
	20					25		
Asp	Val	Asn	Gly	Ser	His	Gly	Arg	Gln
		30					35	
Val	Cys	Arg	Arg	His	Glu	Leu	Tyr	Val
			40					45

Ser	Phe	Gln	Asp	Leu	Gly	Trp	Leu	Asp
				50				
Trp	Val	Ile	Ala	Pro	Gln	Gly	Tyr	Ser
55					60			
Ala	Tyr	Tyr	Cys	Glu	Gly	Glu	Cys	Ser
	65					70		
Phe	Pro	Leu	Asp	Ser	Cys	Met	Asn	Ala
		75					80	
Thr	Asn	His	Ala	Ile	Leu	Gln	Ser	Leu
			85					90
Val	His	Leu	Met	Lys	Pro	Asn	Ala	Val
				95				
Pro	Lys	Ala	Cys	Cys	Ala	Pro	Thr	Lys
100					105			
Leu	Ser	Ala	Thr	Ser	Val	Leu	Tyr	Tyr
	110					115		
Asp	Ser	Ser	Asn	Asn	Val	Ile	Leu	Arg
		120					125	
Lys	Ala	Arg	Asn	Met	Val	Val	Lys	Ala
			130					135
Cys	Gly	Cys	His.					

4. The polypeptide chain of claim 1 wherein the sequence comprises (Sequence ID No. 7):

Cys	Xaa	Xaa	Xaa	Xaa	Xaa	Xaa	Xaa	Xaa	Xaa	Xaa	Xaa
1					5					10	
Xaa	Xaa	Xaa	Xaa	Xaa	Xaa	Xaa	Xaa	Xaa	Xaa	Xaa	Xaa
					15					20	
Xaa	Xaa	Xaa	Xaa	Xaa	Xaa	Xaa	Xaa	Cys	Xaa	Xaa	Xaa
					25			30			
Cys	Xaa	Xaa	Xaa	Xaa	Xaa	Xaa	Cys	Xaa	Xaa	Xaa	Xaa
					35			40			

-77-

-77-

-77-

-77-

Xaa Xaa Xaa Xaa Xaa Xaa Xaa Xaa Xaa Xaa Xaa  
70 75  
Xaa Xaa Xaa Xaa Xaa Xaa Xaa Xaa Xaa Xaa Xaa  
80 85  
Xaa Xaa Xaa Xaa Xaa Cys Xaa Cys Xaa  
90 95

wherein each Xaa independently represents one of the 20 naturally occurring L-isomer,  $\alpha$ -amino acids, and together with said 7 cysteine residues define said polypeptide chain.

6. A polypeptide chain useful as a subunit of a dimeric osteogenic protein, said protein being capable of inducing endochondral bone formation when implanted in a mammal in association with a matrix; said polypeptide chain comprising the amino acid sequence (Sequence ID No. 5):

Cys Xaa<sub>1</sub> Xaa<sub>2</sub> His Glu Leu Tyr Val Xaa<sub>3</sub> Phe  
1 5 10  
Xaa<sub>4</sub> Asp Leu Gly Trp Xaa<sub>5</sub> Asp Trp Xaa<sub>6</sub> Ile  
15 20  
Ala Pro Xaa<sub>7</sub> Gly Tyr Xaa<sub>8</sub> Ala Tyr Tyr Cys  
25 30  
Glu Gly Cys Xaa<sub>9</sub> Phe Pro Leu Xaa<sub>10</sub> Ser Xaa<sub>11</sub>  
35 40  
Met Asn Ala Thr Asn His Ala Ile Xaa<sub>12</sub> Thr  
45 50  
Leu Xaa<sub>13</sub> Xaa<sub>14</sub> Xaa<sub>15</sub> Xaa<sub>16</sub> Xaa<sub>17</sub> Xaa<sub>18</sub> Val  
55  
Pro Lys Xaa<sub>19</sub> Cys Cys Ala Pro Thr Xaa<sub>20</sub> Leu  
60 65

Xaa<sub>21</sub> Ala Xaa<sub>22</sub> Ser Val Leu Tyr Xaa<sub>23</sub> Asp  
70 75

Xaa<sub>24</sub> Ser Xaa<sub>25</sub> Asn Val Xaa<sub>26</sub> Leu Xaa<sub>27</sub> Lys  
80 85

Xaa<sub>28</sub> Pro Asn Met Val Val Xaa<sub>29</sub> Ala Cys Gly  
90 95

Cys His,

wherein Xaa<sub>1</sub> = (Lys or Arg); Xaa<sub>2</sub> = (Lys or Arg);  
Xaa<sub>3</sub> = (Ser or Arg); Xaa<sub>4</sub> = (Arg or Gln); Xaa<sub>5</sub> = (Gln  
or Leu); Xaa<sub>6</sub> = (Ile or Val); Xaa<sub>7</sub> = (Glu or Gln);  
Xaa<sub>8</sub> = (Ala or Ser); Xaa<sub>9</sub> = (Ala or Ser); Xaa<sub>10</sub> =  
(Asn or Asp); Xaa<sub>11</sub> = (Tyr or Cys); Xaa<sub>12</sub> = (Val or  
Leu); Xaa<sub>13</sub> = (His or Asn); Xaa<sub>14</sub> = (Phe or Leu);  
Xaa<sub>15</sub> = (Ile or Met); Xaa<sub>16</sub> = (Asn or Lys); Xaa<sub>17</sub> =  
(Glu, Asp or Asn); Xaa<sub>18</sub> = (Thr, Ala or Val); Xaa<sub>19</sub> =  
(Pro or Ala); Xaa<sub>20</sub> = (Gln or Lys); Xaa<sub>21</sub> = (Asn or  
Ser); Xaa<sub>22</sub> = (Ile or Thr); Xaa<sub>23</sub> = (Phe or Tyr);  
Xaa<sub>24</sub> = (Asp, Glu or Ser); Xaa<sub>25</sub> = (Ser or Asn); Xaa<sub>26</sub>  
= (Ile or Asp); Xaa<sub>27</sub> = (Lys or Arg); Xaa<sub>28</sub> = (Tyr,  
Ala or His); and Xaa<sub>29</sub> = (Arg or Lys).

7. The polypeptide chain of claim 6 wherein  
Xaa<sub>11</sub> = Cys.

8. A polypeptide chain useful as a subunit of a  
dimeric osteogenic protein, said protein being  
capable of inducing endochondral bone formation when  
implanted in a mammal in association with a matrix;  
the amino acid sequence of said polypeptide  
chain being at least 70% homologous with the amino  
acid sequence (Sequence ID No. 1):

mOP-2

Ala 1	Ala	Arg	Pro	Leu 5	Lys	Arg	Arg	Gln
Pro 10	Lys	Lys	Thr	Asn	Glu 15	Leu	Pro	His
Pro 20	Asn	Lys	Leu	Pro	Gly	Ile 25	Phe	Asp
Asp	Gly	His 30	Gly	Ser	Arg	Gly	Arg 35	Glu
Val	Cys	Arg	Arg 40	His	Glu	Leu	Tyr	Val 45
Arg	Phe	Arg	Asp	Leu 50	Gly	Trp	Leu	Asp
Trp 55	Val	Ile	Ala	Pro	Gln 60	Gly	Tyr	Ser
Ala 65	Tyr	Tyr	Cys	Glu	Gly	Glu 70	Cys	Ala
Phe	Pro	Leu 75	Asp	Ser	Cys	Met	Asn 80	Ala
Thr	Asn	His	Ala 85	Ile	Leu	Gln	Ser	Leu 90
Val	His	Leu	Met	Lys 95	Pro	Asp	Val	Val
Pro 100	Lys	Ala	Cys	Cys	Ala 105	Pro	Thr	Lys
Leu 110	Ser	Ala	Thr	Ser	Val	Leu 115	Tyr	Tyr
Asp	Ser	Ser 120	Asn	Asn	Val	Ile	Leu 125	Arg
Lys	His	Arg	Asn 130	Met	Val	Val	Lys	Ala 135
Cys	Gly	Cys	His.					

9. The polypeptide chain of claim 8 wherein the amino acid sequence is at least 80% homologous with the amino acid sequence (Sequence ID No. 1):

mOP-2

Ala	Ala	Arg	Pro	Leu	Lys	Arg	Arg	Gln
1				5				
Pro	Lys	Lys	Thr	Asn	Glu	Leu	Pro	His
10					15			
Pro	Asn	Lys	Leu	Pro	Gly	Ile	Phe	Asp
	20					25		
Asp	Gly	His	Gly	Ser	Arg	Gly	Arg	Glu
		30					35	
Val	Cys	Arg	Arg	His	Glu	Leu	Tyr	Val
			40					45
Arg	Phe	Arg	Asp	Leu	Gly	Trp	Leu	Asp
				50				
Trp	Val	Ile	Ala	Pro	Gln	Gly	Tyr	Ser
55					60			
Ala	Tyr	Tyr	Cys	Glu	Gly	Glu	Cys	Ala
	65					70		
Phe	Pro	Leu	Asp	Ser	Cys	Met	Asn	Ala
		75					80	
Thr	Asn	His	Ala	Ile	Leu	Gln	Ser	Leu
			85					90
Val	His	Leu	Met	Lys	Pro	Asp	Val	Val
				95				
Pro	Lys	Ala	Cys	Cys	Ala	Pro	Thr	Lys
100					105			
Leu	Ser	Ala	Thr	Ser	Val	Leu	Tyr	Tyr
	110					115		
Asp	Ser	Ser	Asn	Asn	Val	Ile	Leu	Arg
		120					125	



Lys	His	Arg	Asn	Met	Val	Val	Lys	Ala
			130					135
Cys	Gly	Cys	His.					

10. The polypeptide chain of claim 8 wherein the amino acid sequence comprises (Sequence ID No. 1):

mOP-2

Ala	Ala	Arg	Pro	Leu	Lys	Arg	Arg	Gln
1				5				
Pro	Lys	Lys	Thr	Asn	Glu	Leu	Pro	His
10					15			
Pro	Asn	Lys	Leu	Pro	Gly	Ile	Phe	Asp
	20					25		
Asp	Gly	His	Gly	Ser	Arg	Gly	Arg	Glu
		30					35	
Val	Cys	Arg	Arg	His	Glu	Leu	Tyr	Val
			40					45
Arg	Phe	Arg	Asp	Leu	Gly	Trp	Leu	Asp
				50				
Trp	Val	Ile	Ala	Pro	Gln	Gly	Tyr	Ser
55					60			
Ala	Tyr	Tyr	Cys	Glu	Gly	Glu	Cys	Ala
	65					70		
Phe	Pro	Leu	Asp	Ser	Cys	Met	Asn	Ala
		75					80	
Thr	Asn	His	Ala	Ile	Leu	Gln	Ser	Leu
			85					90
Val	His	Leu	Met	Lys	Pro	Asp	Val	Val
				95				
Pro	Lys	Ala	Cys	Cys	Ala	Pro	Thr	Lys
100					105			

Leu	Ser	Ala	Thr	Ser	Val	Leu	Tyr	Tyr
	110					115		
Asp	Ser	Ser	Asn	Asn	Val	Ile	Leu	Arg
		120					125	
Lys	His	Arg	Asn	Met	Val	Val	Lys	Ala
			130					135
Cys	Gly	Cys	His.					

11. The polypeptide chain of claim 8 wherein the amino acid sequence comprises (Sequence ID No. 3):

hOP-2

Ala	Val	Arg	Pro	Leu	Arg	Arg	Arg	Gln
1				5				
Pro	Lys	Lys	Ser	Asn	Glu	Leu	Pro	Gln
10					15			
Ala	Asn	Arg	Leu	Pro	Gly	Ile	Phe	Asp
	20					25		
Asp	Val	Asn	Gly	Ser	His	Gly	Arg	Gln
		30					35	
Val	Cys	Arg	Arg	His	Glu	Ile	Tyr	Val
			40					45
Ser	Phe	Gln	Asp	Leu	Gly	Trp	Leu	Asp
				50				
Trp	Val	Ile	Ala	Pro	Gln	Gly	Tyr	Ser
55					60			
Ala	Tyr	Tyr	Cys	Glu	Gly	Glu	Cys	Ser
	65					70		
Phe	Pro	Leu	Asp	Ser	Cys	Met	Asn	Ala
		75					80	
Thr	Asn	His	Ala	Ile	Leu	Gln	Ser	Leu
			85					90

Val	His	Leu	Met	Lys	Pro	Asn	Ala	Val
				95				
Pro	Lys	Ala	Cys	Cys	Ala	Pro	Thr	Lys
100					105			
Leu	Ser	Ala	Thr	Ser	Val	Leu	Tyr	Tyr
	110					115		
Asp	Glu	Ser	Asn	Asn	Val	Ile	Leu	Arg
		120					125	
Lys	Ala	Arg	Asn	Met	Val	Val	Lys	Ala
			130					135
Cys	Gly	Cys	His.					

12. The polypeptide chain of claim 8 wherein the amino acid sequence comprises (SEQ ID NO. 9):

hOP-2P

			Pro	Leu	Arg	Arg	Arg	Gln
			1				5	
Pro	Lys	Lys	Ser	Asn	Glu	Leu	Pro	Gln
			10					15
Ala	Asn	Arg	Leu	Pro	Gly	Ile	Phe	Asp
				20				
Asp	Val	Asn	Gly	Ser	His	Gly	Arg	Gln
25					30			
Val	Cys	Arg	Arg	His	Glu	Leu	Tyr	Val
	35					40		
Ser	Phe	Gln	Asp	Leu	Gly	Trp	Leu	Asp
		45					50	
Tyr	Val	Ile	Ala	Pro	Gln	Gly	Tyr	Ser
			55					60
Ala	Tyr	Tyr	Cys	Glu	Gly	Glu	Cys	Ser
				65				

Phe 70	Pro	Leu	Asp	Ser	Cys 75	Met	Asn	Ala
Thr	Asn 80	His	Ala	Ile	Leu	Gln 85	Ser	Leu
Val	His	Leu 90	Met	Lys	Pro	Asn	Ala 95	Val
Pro	Lys	Ala	Cys 100	Cys	Ala	Pro	Thr	Lys 105
Leu	Ser	Ala	Thr	Ser 110	Val	Leu	Tyr	Tyr
Asp 115	Glu	Ser	Asn	Asn	Val 120	Ile	Leu	Arg
Lys	Ala 125	Arg	Asn	Met	Val	Val 130	Lys	Ala
Cys	Gly	Cys 135	His.					

13. The polypeptide chain of claim 8 wherein the amino acid sequence comprises (SEQ ID NO. 10):

hOP-2R

						Arg 1	Arg	Gln
Pro	Lys 5	Lys	Ser	Asn	Glu	Leu 10	Pro	Gln
Ala	Asn	Arg 15	Leu	Pro	Gly	Ile	Phe 20	Asp
Asp	Val	Asn	Gly 25	Ser	His	Gly	Arg	Gln 30
Val	Cys	Arg	Arg	His 35	Glu	Leu	Tyr	Val

Ser 40	Phe	Gln	Asp	Leu	Gly 45	Trp	Leu	Asp
Tyr	Val 50	Ile	Ala	Pro	Gln	Gly 55	Tyr	Ser
Ala	Tyr	Tyr 60	Cys	Glu	Gly	Glu	Cys 65	Ser
Phe	Pro	Leu	Asp 70	Ser	Cys	Met	Asn	Ala 75
Thr	Asn	His	Ala	Ile 80	Leu	Gln	Ser	Leu
Val 85	His	Leu	Met	Lys	Pro 90	Asn	Ala	Val
Pro	Lys 95	Ala	Cys	Cys	Ala	Pro 100	Thr	Lys
Leu	Ser	Ala 105	Thr	Ser	Val	Leu	Tyr 110	Tyr
Asp	Glu	Ser	Asn 115	Asn	Val	Ile	Leu	Arg 120
Lys	Ala	Arg	Asn 125	Met	Val	Val	Lys	Ala
Cys 130	Gly	Cys	His.					

14. The polypeptide chain of claim 8 wherein the amino acid sequence comprises (SEQ ID NO. 11):

hOP-2S

						Ser 1	Gln	Gln
Pro	Phe 5	Val	Val	Thr	Phe	Phe 10	Arg	Ala
Ser	Pro	Ser 15	Pro	Ile	Arg	Thr	Pro 20	Arg

Ala	Val	Arg	Pro	Leu	Arg	Arg	Arg	Gln
			25					30
Pro	Lys	Lys	Ser	Asn	Glu	Leu	Pro	Gln
				35				
Ala	Asn	Arg	Leu	Pro	Gly	Ile	Phe	Asp
40					45			
Asp	Val	Asn	Gly	Ser	His	Gly	Arg	Gln
	50					55		
Val	Cys	Arg	Arg	His	Glu	Leu	Tyr	Val
		60					65	
Ser	Phe	Gln	Asp	Leu	Gly	Trp	Leu	Asp
			70					75
Tyr	Val	Ile	Ala	Pro	Gln	Gly	Tyr	Ser
				80				
Ala	Tyr	Tyr	Cys	Glu	Gly	Glu	Cys	Ser
85					90			
Phe	Pro	Leu	Asp	Ser	Cys	Met	Asn	Ala
	95					100		
Thr	Asn	His	Ala	Ile	Leu	Gln	Ser	Leu
		105					110	
Val	His	Leu	Met	Lys	Pro	Asn	Ala	Val
			115					120
Pro	Lys	Ala	Cys	Cys	Ala	Pro	Thr	Lys
				125				
Leu	Ser	Ala	Thr	Ser	Val	Leu	Tyr	Tyr
130					135			
Asp	Glu	Ser	Asn	Asn	Val	Ile	Leu	Arg
	140					145		
Lys	Ala	Arg	Asn	Met	Val	Val	Lys	Ala
		150					165	
Cys	Gly	Cys	His.					
			170					

15. A polypeptide chain useful as a subunit of a dimeric osteogenic protein, said protein being capable of inducing endochondral bone formation when implanted in a mammal in association with a matrix; said polypeptide chain having an amino acid sequence comprising (Sequence ID No. 2):

Prepro mOP--2

	Met	Ala	Met	Arg	Pro	Gly	Pro	Leu
	1				5			
Trp	Leu	Leu	Gly	Leu	Ala	Leu	Cys	Ala
	10					15		
Leu	Gly	Gly	Gly	His	Gly	Pro	Gly	Pro
		20					25	
Pro	His	Thr	Cys	Pro	Gln	Arg	Arg	Leu
			30					35
Gly	Ala	Arg	Asp	Arg	Asp	Met	Gln	Arg
				40				
Glu	Ile	Leu	Ala	Val	Leu	Gly	Leu	Pro
45					50			
Gly	Arg	Pro	Asp	Pro	Val	His	Asn	Pro
	55					50		
Pro	Leu	Pro	Gly	Thr	Gln	Arg	Ala	Pro
		65				70		
Leu	Phe	Met	Leu	Asp	Leu	Tyr	His	Ala
			70				80	
Met	Thr	Asp	Asp	Asp	Asp	Gly	Gly	Pro
				85				
Pro	Gln	Ala	His	Leu	Gly	Arg	Ala	Asp
90					95			
Leu	Val	Met	Ser	Phe	Val	Asn	Met	Val
	100					105		

Glu	Arg	Asp 110	Arg	Thr	Leu	Gly	Tyr 115	Gln
Glu	Pro	His	Trp 120	Lys	Glu	Phe	His	Phe 125
Asp	Leu	Thr	Gln	Ile 130	Pro	Ala	Gly	Glu
Ala 135	Val	Thr	Ala	Ala	Glu 140	Phe	Arg	Ile
Tyr	Lys 145	Glu	Pro	Ser	Thr	His 150	Pro	Leu
Asn	Thr	Thr 155	Leu	His	Ile	Ser	Met 160	Phe
Glu	Val	Val	Gln 165	Glu	His	Ser	Asn	Arg 170
Glu	Ser	Asp	Leu	Phe	Phe	Leu	Asp	Leu
Gln 180	Thr	Leu	Arg	Ser	Gly 185	Asp	Glu	Gly
Trp	Leu 190	Val	Leu	Asp	Ile	Thr 195	Ala	Ala
Ser	Asp	Arg 200	Trp	Leu	Leu	Asn	His 205	His
Lys	Asp	Leu	Gly 210	Leu	Arg	Leu	Tyr	Val 215
Glu	Thr	Ala	Asp	Gly 220	His	Ser	Met	Asp
Pro 225	Gly	Leu	Ala	Gly	Leu 230	Leu	Gly	Arg
Gln	Ala 235	Pro	Arg	Ser	Arg	Gln 240	Pro	Phe
Met	Val	Thr 245	Phe	Phe	Arg	Ala	Ser 250	Gln
Ser	Pro	Val	Arg 255	Ala	Pro	Arg	Ala	Ala 260



Arg	Pro	Leu	Lys	Arg	Arg	Gln	Pro	Lys
				265				
Lys	Thr	Asn	Glu	Leu	Pro	His	Pro	Asn
270					275			
Lys	Leu	Pro	Gly	Ile	Phe	Asp	Asp	Gly
	280					285		
His	Gly	Ser	Arg	Gly	Arg	Glu	Val	Cys
		290					295	
Arg	Arg	His	Glu	Leu	Tyr	Val	Arg	Phe
			300					305
Arg	Asp	Leu	Gly	Trp	Leu	Asp	Trp	Val
				310				
Ile	Ala	Pro	Gln	Gly	Tyr	Ser	Ala	Tyr
315					320			
Tyr	Cys	Glu	Gly	Glu	Cys	Ala	Phe	Pro
	325					330		
Leu	Asp	Ser	Cys	Met	Asn	Ala	Thr	Asn
		335					340	
His	Ala	Ile	Leu	Gln	Ser	Leu	Val	His
			345					350
Leu	Met	Lys	Pro	Asp	Val	Val	Pro	Lys
				355				
Ala	Cys	Cys	Ala	Pro	Thr	Lys	Leu	Ser
360					365			
Ala	Thr	Ser	Val	Leu	Tyr	Tyr	Asp	Ser
	370					375		
Ser	Asn	Asn	Val	Ile	Leu	Arg	Lys	His
		380					385	
Arg	Asn	Met	Val	Val	Lys	Ala	Cys	Gly
			390					395
Cys	His.							

16. A polypeptide chain useful as a subunit of a dimeric osteogenic protein, said protein being

capable of inducing endochondral bone formation when implanted in a mammal in association with a matrix;  
said polypeptide chain comprising the amino acid sequence (Sequence ID No. 4):

Prepro hOP-2

Met	Thr	Ala	Leu	Pro	Gly	Pro	Leu	Trp
1				5				
Leu	Leu	Gly	Leu	Ala	Leu	Cys	Ala	Leu
10					15			
Gly	Gly	Gly	Gly	Pro	Gly	Leu	Arg	Pro
	20					25		
Pro	Pro	Gly	Cys	Pro	Gln	Arg	Arg	Leu
		30					35	
Gly	Ala	Arg	Asp	Arg	Asp	Val	Gln	Arg
			40					45
Glu	Ile	Leu	Ala	Val	Leu	Gly	Leu	Pro
				50				
Gly	Arg	Pro	Arg	Pro	Arg	Ala	Pro	Pro
55					60			
Ala	Ala	Ser	Arg	Leu	Pro	Ala	Ser	Ala
	65					70		
Pro	Leu	Phe	Met	Leu	Asp	Leu	Tyr	His
		75					80	
Arg	Met	Ala	Gly	Asp	Asp	Asp	Glu	Asp
			85					90
Gly	Ala	Ala	Glu	Ala	Leu	Gly	Arg	Ala
				95				
Asp	Leu	Val	Met	Ser	Phe	Val	Asn	Met
100					105			
Val	Glu	Arg	Asp	Arg	Ala	Leu	Gly	His
	110					115		

Gln	Glu	Pro	His	Trp	Lys	Glu	Phe	Arg
		120					125	
Phe	Asp	Leu	Thr	Gln	Ile	Pro	Ala	Gly
			130					135
Glu	Ala	Val	Thr	Ala	Ala	Glu	Phe	Arg
				140				
Ile	Tyr	Lys	Val	Pro	Ser	Ile	His	Leu
145					150			
Leu	Asn	Arg	Thr	Leu	His	Val	Ser	Met
	155					160		
Phe	Gln	Val	Val	Gln	Glu	Gln	Ser	Asn
		165					170	
Arg	Glu	Ser	Asp	Leu	Phe	Phe	Leu	Asp
			175					180
Leu	Gln	Thr	Leu	Arg	Ala	Gly	Asp	Glu
				185				
Gly	Trp	Leu	Val	Leu	Asp	Val	Thr	Ala
190					195			
Ala	Ser	Asp	Cys	Trp	Leu	Leu	Lys	Arg
	200					205		
His	Lys	Asp	Leu	Gly	Leu	Arg	Leu	Tyr
		210					215	
Val	Glu	Thr	Glu	Asp	Gly	Pis	Ser	Val
			220					225
Asp	Pro	Gly	Leu	Ala	Gly	Leu	Leu	Gly
				230				
Gln	Arg	Ala	Pro	Arg	Ser	Gln	Gln	Pro
235					240			
Phe	Val	Val	Thr	Phe	Phe	Arg	Ala	Ser
	245					250		
Pro	Ser	Pro	Ile	Arg	Thr	Pro	Arg	Ala
		255					260	

Val	Arg	Pro	Leu	Arg	Arg	Arg	Gln	Pro
			265					270
Lys	Lys	Ser	Asn	Glu	Leu	Pro	Gln	Ala
			275					
Asn	Arg	Leu	Pro	Gly	Ile	Phe	Asp	Asp
280				285				
Val	His	Gly	Ser	His	Gly	Arg	Gln	Val
	290					295		
Cys	Arg	Arg	His	Glu	Leu	Tyr	Val	Ser
		300					305	
Phe	Gln	Asp	Leu	Gly	Trp	Leu	Asp	Trp
			310					315
Val	Ile	Ala	Pro	Gln	Gly	Tyr	Ser	Ala
			320					
Tyr	Tyr	Cys	Glu	Gly	Glu	Cys	Ser	Phe
325				330				
Pro	Leu	Asp	Ser	Cys	Met	Asn	Ala	Thr
	335					340		
Asn	His	Ala	Ile	Leu	Gln	Ser	Leu	Val
		345					350	
His	Leu	Met	Lys	Pro	Asn	Ala	Val	Pro
			355					360
Lys	Ala	Cys	Cys	Ala	Pro	Thr	Lys	Leu
			365					
Ser	Ala	Thr	Ser	Val	Leu	Tyr	Tyr	Asp
370				375				
Ser	Ser	Asn	Asn	Val	Ile	Leu	Arg	Lys
	380					385		
Ala	Arg	Asn	Met	Val	Val	Lys	Ala	Cys
		390					395	
Gly	Cys	His.						

17. A dimeric osteogenic protein capable of inducing endochondral bone formation in a mammal when

implanted in said mammal in association with a matrix;  
said protein comprising a pair of  
disulfide-bonded polypeptide chains constituting a  
dimeric species, wherein each said polypeptide chain  
is the polypeptide chain of claim 1, 6, 8, 15 or 16.

18. The polypeptide chain of claim 1, 6, 8, 15  
or 16 produced by expression of recombinant DNA in a  
host cell.

19. The polypeptide chain of claim 15 wherein  
said host cell is a procaryotic host cell.

20. The polypeptide chain of claim 15 wherein  
said host cell is a mammalian cell.

21. The polypeptide of claim 1, 6, 8, 15 or 16  
that is glycosylated.

22. A DNA encoding the polypeptide chain of  
claim 1, 6, 8, 15 or 16.

23. A dimeric protein comprising a pair of  
polypeptide chains expressed from a DNA sequence  
sufficiently duplicative of the sequence of Sequence  
ID No. 2 or Sequence ID No. 4 such that, when said  
polypeptide chains are oxidized to produce a  
disulfide-bonded dimeric species, the dimeric species  
has a conformation that is capable of inducing  
endochondral bone or cartilage formation when  
disposed within a matrix and implanted in a mammal.